WHAT IS CLAIMED IS:

[CLAIM 1] A polarization control optical space switch, comprising:

a combination of a plurality of polarization control optical switches, each of said polarization control optical switches comprising: polarization control means having elements, the number of which is equal to the number of light paths, for rotating the polarizing direction of incident light information through 90° or otherwise retaining the polarizing direction thereof with no introduction of rotation; and a light path routing element for routing the light path for the light information output from said polarization control means in accordance with the polarizing direction of the light information.

[CLAIM 2] A polarization control optical space switch according to claim 1, wherein

said light path routing element comprises:

polarization splitting means which transmits incident light information therethrough when the polarizing direction thereof is p-polarization that is parallel to the plane of incidence, and which reflects incident light information when the polarizing direction thereof is s-polarization that is perpendicular to the plane of incidence;

a transmitted-side $\lambda/4$ wavelength plate which is located on the output side of the p-polarized light

transmitted by said polarization splitting means and is positioned perpendicular to the travelling direction of the transmitted light information, and which functions to rotate the polarizing direction of the light information by $\pi/4$;

a transmitted-side reflection block, located behind said transmitted-side $\lambda/4$ wavelength plate, for reflecting the light information incident from said transmitted-side $\lambda/4$ wavelength plate back into said transmitted-side $\lambda/4$ wavelength plate along a light path adjacent to the light path of the incident light information;

a reflected-side $\lambda/4$ wavelength plate which is located on the output side of the s-polarized light reflected by said polarization splitting means and is positioned perpendicular to the travelling direction of the reflected light information, and which functions to rotate the polarizing direction of the light information by $\pi/4$; and

a reflected-side reflection block, located behind said reflected-side $\lambda/4$ wavelength plate, for reflecting the light information incident from said reflected-side $\lambda/4$ wavelength plate back into said reflected-side $\lambda/4$ wavelength plate along a light path adjacent to the light path of the incident light information.

[CLAIM 3] A polarization control optical space switch according to claim 1, wherein

said light path routing element comprises:

a first polarized-light routing element for shifting the light path of light information in accordance with the polarizing direction of the light information output from said polarization control means;

a phase element for rotating through 90° the polarizing direction of light information incident along a particular light path from said first routing element; and

a second polarized-light routing element for shifting the light path of light information, in accordance with the polarizing direction of the light information output from said phase element, in a direction opposite to the shifting direction of said first polarized-light routing element.

[CLAIM 4] A polarization control optical space switch according to claim 3, wherein

said plurality of polarization control optical switches are arranged in cascade along the light paths of light information travelling in parallel to each other,

said phase element in each of said polarization control optical switches rotates through 90° the polarizing direction of the light information incident from said first polarized-light routing element except those portions incident along the outermost light paths, and

said first polarized-light routing element and said second polarized-light routing element shift each light information to an adjacent light path for output.

[CLAIM 5] A polarization control optical space switch according to claim 4, wherein

said first polarized-light routing element transmits incident light information therethrough when the polarizing direction thereof is p-polarization, and shifts the light path of incident light information upward when the polarizing direction thereof is s-polarization, and

said second polarized-light routing element transmits incident light information therethrough when the polarizing direction thereof is p-polarization, and shifts the light path of incident light information downward when the polarizing direction thereof is s-polarization.

[CLAIM 6] A polarization control optical space switch according to claim 4, wherein

said first polarized-light routing element transmits incident light information therethrough when the polarizing direction thereof is p-polarization, and shifts the light path of incident light information downward when the polarizing direction thereof is s-polarization, and

said second polarized-light routing element transmits incident light information therethrough when

the polarizing direction thereof is p-polarization, and shifts the light path of incident light information upward when the polarizing direction thereof is s-polarization.

[CLAIM 7] A polarization control optical space switch according to claim 4, wherein

said first polarized-light routing element and said second polarized-light routing element are each constructed from a birefringent plate.

[CLAIM 8] A polarization control optical space switch according to claim 4, wherein

said first polarized-light routing element and said second polarized-light routing element are each constructed from a polarizing beam splitter array consisting of a combination of a plurality of polarizing beam splitters.

[CLAIM 9] A polarization control optical space switch according to claim 4, wherein

said first polarized-light routing element and said second polarized-light routing element are each constructed from a liquid-crystal hologram.

[CLAIM 10] A polarization control optical space switch according to claim 4, wherein

said phase element is constructed from a $\lambda/2$ wavelength plate array comprising light-transmitting members at both ends with a $\lambda/2$ wavelength plate sandwiched therebetween.

[CLAIM 11] A polarization control optical space switch according to claim 1, wherein

said polarization control means comprises a combination of: an element that rotates the polarizing direction of incident light when voltage is applied and that does not rotate the polarizing direction of incident light when no voltage is applied; and an element that does not rotate the polarizing direction of incident light when voltage is applied and that rotates the polarizing direction of incident light when no voltage is applied.

[CLAIM 12] A polarization control optical space switch according to claim 1, wherein

when the number of input/output light paths of said polarization control optical space switch is denoted by m, and the number of input/output light paths of each of said polarization control optical switches is denoted by m, said polarization control optical switches equalling m in number are arranged in series, and the polarization control means in a designated polarization control optical switch is controlled so that the light information incident from each of the m input light paths is output on a desired output light path selected from among the m output light paths.

[CLAIM 13] A polarization control optical space switch according to claim 1, wherein

when the number of input/output light paths of said

polarization control optical space switch is denoted by m, and the number of input/output light paths of each of said polarization control optical switches is denoted by m, said polarization control optical switches equalling (m - 1) in number are arranged in series, and the polarization control means in a designated polarization control optical switch is controlled so that the light information incident from each of the m input light paths is output on a desired output light path selected from among the m output light paths.

[CLAIM 14] A polarization control optical space switch according to claim 1, wherein

polarization control optical space switches, each having m input/output light paths, are arranged as a matrix array of n rows and n columns,

a number, m x n, of input optical switches, each having one input and n outputs, are arranged on the input side of said switch matrix array, and

a number, m x n, of output optical switches, each having n inputs and one output, are arranged on the output side of said switch matrix array, and

when said input light paths totalling m x n in number are arranged in n groups of m input light paths, with a j-th input light path in an i-th group designated as #(i,j) (where $1 \leq i \leq n$, $1 \leq j \leq m$), and said output light paths totalling m x n in number are arranged in n groups of m output light paths, with an s-th output light path

in an r-th group designated as #(r,s) (where $1 \leq r \leq n$, $1 \leq s \leq m$),

the n outputs of a one-input, n-output switch corresponding to said input light path #(i,j) are connected to the j-th input light paths of the polarization control optical space switches arranged in the i-th row of said switch matrix array, and

the s-th outputs of the polarization control optical space switches arranged in the r-th column of said switch matrix array are connected to an output optical switch corresponding to said output light path #(r,s).

[CLAIM 15] A polarization control optical space switch according to claim 1, wherein

polarization control optical space switches, each having n input/output light paths, are stacked in m layers to form a switch block A,

on the input side of said switch block A, polarization control optical space switches, each having m input/output light paths, are stacked in n layers, extending at right angles with the layers of said switch block A, to form an input switch block B, and

on the output side of said switch block A, polarization control optical space switches, each having m input/output light paths, are stacked in n layers, extending at right angles with the layers of said switch block A, to form an output switch block C, said switch blocks A, B, and C being coupled in cascade with each

other.

[CLAIM 16] A polarization control optical space switch according to claim 15, wherein

an input reflection plate is placed on the input side of said switch block A, and an output reflection plate on the output side of said switch block A, so that:

light information output from said input switch block B is reflected by said input reflection plate for entrance into said switch block A; and

light information output from said switch block A is reflected by said output reflection plate for entrance into said output switch block C.

[CLAIM 17] A polarization control optical space switch according to claim 16, wherein

a liquid-crystal hologram (a) is placed on the output side of said input switch block B, and a liquid-crystal hologram (b) on the input side of said switch block A, and

a liquid-crystal hologram (c) is placed on the output side of said switch block A, and a liquid-crystal hologram (d) on the input side of said output switch block C, so that:

light information output from said input switch block B is diffracted by said liquid-crystal hologram (a) for entrance into said input reflection plate;

the light information reflected by said input

reflection plate is diffracted by said liquid-crystal hologram (b) for entrance into said switch block A;

the light information output from said switch block A is diffracted by said liquid-crystal hologram (c) for entrance into said output reflection plate; and

the light information reflected by said output reflection plate is diffracted by said liquid-crystal hologram (d) for entrance into said output switch block B.

[CLAIM 18] A polarization control optical space switch according to claim 1, comprising:

a polarization control optical space switch block consisting of two polarization control optical space switches arranged in parallel with each other;

input polarization control means for rotating the polarizing direction of incident light through 90° or otherwise retaining the polarizing direction thereof for output;

polarization splitting means for directing the light information, output from said input polarization control means, to one or other of said polarization control optical space switches in said polarization control optical space switch block in accordance with the polarizing direction of the light information;

polarization correcting means for outputting the light information, output from said polarization control optical space switch block, onto a designated light

path; and

output polarization control means for rotating through 90° the polarizing direction of the light information output from said polarization correcting means or otherwise retaining the polarizing direction thereof for output.

[CLAIM 19] A polarization control optical space switch according to claim 18, wherein of said two polarization control optical space switches, one is an s-polarization control optical space switch for switching the light path for incident s-polarized light whose polarizing direction is perpendicular to the plane of incidence, and the other is a p-polarization control optical space switch for switching the light path for incident p-polarized light whose polarizing direction is parallel to the plane of incidence.

[CLAIM 20] A polarization control optical space switch according to claim 18, wherein said polarization splitting means and said polarization correcting means are each constructed from a birefringent plate.

[CLAIM 21] A polarization control optical space switch according to claim 18, wherein said polarization splitting means and said polarization correcting means are each constructed from a polarizing beam splitter array consisting of a combination of two polarizing beam splitters.

[CLAIM 22] A polarization control optical space

switch according to claim 18, wherein said polarization splitting means and said polarization correcting means are each constructed from a liquid-crystal hologram.

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